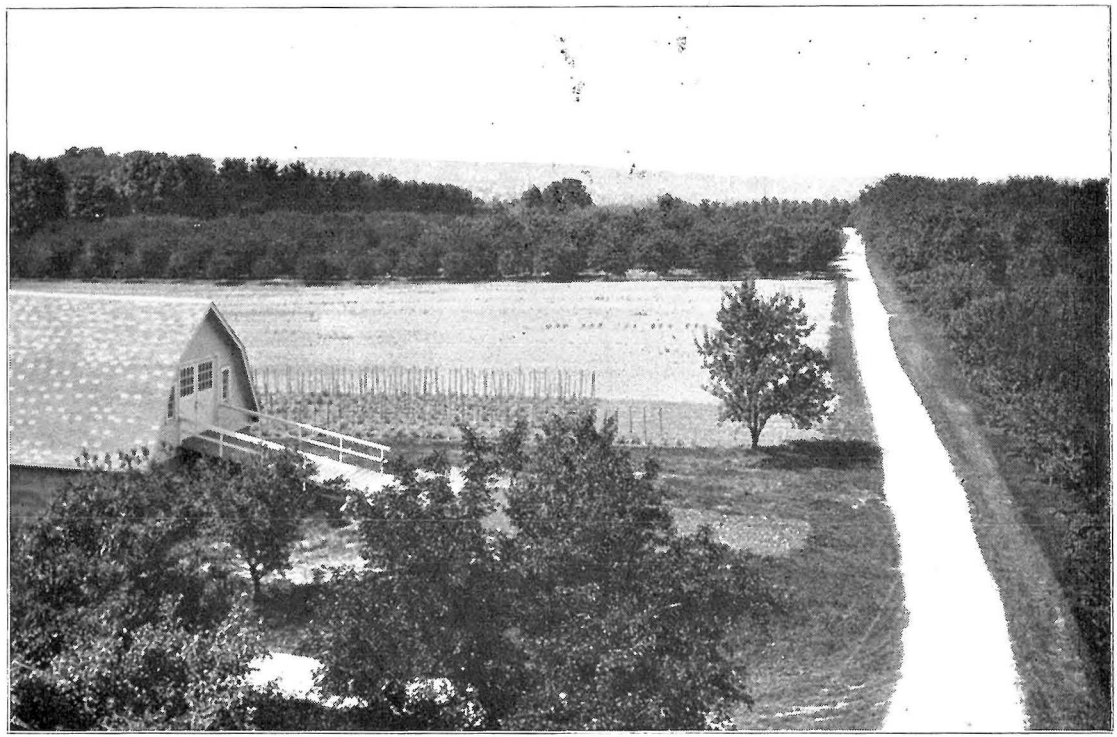
Horticulture

at the

Ohio Agricultural Experiment Station



Station Orchards, looking north, 1929

Special Circular No. 23 August, 1929

HORTICULTURE

AT THE

OHIO AGRICULTURAL EXPERIMENT STATION

WOOSTER, OHIO

CONTENTS

DEPARTMENT OF HORTICULTURE

INCLUDING FRUITS, VEGETABLES, AND FLOWERS

INTRODUCTION

Horticultural work was begun in 1893 when the Station was located at Wooster. Orchards were planted, vegetable and potato tests laid out, and ornamental trees planted on the campus and in suitable places about the farm. The outstanding feature of this earlier work was the testing of varieties. This feature has been continued altho the relative importance and emphasis has shifted to that of a more technical nature. An effort has been made to cover the entire field of horticultural production but obviously only a limited number of problems can be undertaken at any one time.

In addition to the work in progress at Wooster, a number of cooperative projects are conducted with individual orchardists, vineyardists, gardeners, and greenhouse operators. Considerable of the vegetable work is located at the Marietta Truck Station in Washington County. The various county farms are carrying orchard and garden work of importance which constitutes an indispensable part of the Station's work.

This Visitor's Guide is an attempt to summarize briefly the work which is in progress. It does not list nor describe all of the experiments. A personal tour of the farm will more completely cover the projects. Reports are issued as warranted or as the work is completed.

Visitors are welcome at any time. (J. H. Gourley).

POMOLOGY

APPLE VARIETIES

Several hundred varieties of apples have been under observation at this Station. Records of yield, dates of blooming, and notes on the behavior of trees and fruit are taken annually. When sufficient information has accumulated it is published: Bulletins 290, 385, 391, 411, and 434.

Varieties on which sufficient data have been collected are removed and replaced by newly developed varieties.

Among the newer varieties that are now attracting attention and that may be seen fruiting in the Station orchards are Melba

(633), Joyce (629), Dolgo crab (652), Gallia Beauty (O. S. 4-16), Cortland (173-514), Banks (510), and Golden Delicious (396-Ext. 411-412).

Yields of Varieties in Station Orchards for 18-year Period, 1910-1927, Ages 17-35 Years

Variety	Trees in record	Average annual production per acre of 40 trees
	No.	*Bu.*
Northern Spy	6	504
Baldwin	5	636
R. I. Greening	2	652
Rome Beauty	3	692
N. W. Greening	2	796
Grimes Golden	2	824
Average of 6 varieties		684
Average of 6 varieties, per tree		17

Other varieties of fruits that may interest the visitor are:
Plums—Imperial Epineuse, Tragedy, Date Prune.
Peaches—South Haven, J. H. Hale, Salberta, Wilma.
Grapes—Caco, Captivator, Portland, Brocton, Urbana.

(C. W. Ellenwood).

The Effect of Pruning on the Total Yield of Fruit Baldwin, Stayman, Gano, and Wilson Red June

Plot	Treatment	1925	1926	1927	1928	Av.
		Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*
1	None	567.4	1469.0	2017.0	1237.0	1322.6
2	Light	598.7	1645.5	1956.0	1047.6	1312.0
3	Heavy	269.8	1267.5	882.0	979.7	849.8
4	Light summer	188.5	1554.5	1310.0	795.3	962.1
5	Heavy summer	273.5	1486.5	1375.0	1055.0	1047.5
6	Light dormant and summer	517.5	1975.0	2289.0	1013.5	1448.8
7	Heavy dormant and summer	216.5	1280.0	1725.0	684.0	976.4

Heavy pruning materially reduced the yield of apples, except in Plots 4 and 5 where the heavy pruned trees had slightly more fruit than the lightly pruned ones. This seems to be explained by the more favorable location of these plots.

Plot 1 yielded as much fruit as Plot 2, but produced smaller and less desirable fruit. Moderate pruning is advocated for most mature orchards.

Varying Degrees of Pruning the Peach

In cooperation with the Catawba Orchard Company

	Percent increase		
	1926	1927	1928
Increase of light pruning over normal pruning (heavy)	30	70	35

(J. H. Gourley).

Peach Pruning Studies, Elberta

Number twigs of various lengths made during third season, average per tree

Length of twig	Light pruned					Heavy pruned				
	Primaries		Second-aries*	Total		Primaries		Second-aries	Total	
	Singled	Branched				Single	Branched			
In.	*No.*	*No.*	*No.*	*No.*	*Pct.*	*No.*	*No.*	*No.*	*No.*	*Pct.*
1—3	163	0	13	176	17.7	41	0	20	61	8.6
4—12	223	2	279	504	50.7	96	0	241	337	47.7
13—24	91	10	133	234	23.5	59	2	152	213	30.1
25—36	18	32	7	57	5.7	40	17	9	66	9.3
37—48	1	22	0	23	2.3	4	25	0	29	4.1
49—60	0	2	0	2	0.2	1	8	0	9	1.1
61—72	0	0	0	0	0	0	4	0	4	0.5
Total	496	68	432	996	.....	241	56	422	714	.....

*The number of secondaries possessed by branched primaries in a given class is not shown, altho records were obtained.

Diameter of Primary Twig Made During the Third Season in Relation to Fruit Setting the Following Year

Diameter	Light pruned			Heavy pruned		
	Flowers	Fruits	Set	Flowers	Fruits	Set
In.	*No.*	*No.*	*Pct.*	*No.*	*No.*	*Pct.*
Less than ¼	398	73	18.3	116	18	14.6
¼ to ½	1,351	146	10.8	900	127	14.2
½ to ¾	509	32	6.3	569	29	5.9
Over ¾	270	9	3.4	255	10	3.9
Total	2,528	260	10.3	1,840	184	10.0

Length of Twig Made During Third Season in Relation to Number Fruits Borne the Following Year

Length of twig	Light pruned				Heavy pruned			
	Primaries		Second-aries	Total	Primaries		Second-aries	Total
	Single	Branched			Single	Branched		
In.	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*
1—3	49	0	0	49	17	0	1	18
4—12	87	4	24	115	64	2	2	68
13—24	20	2	5	27	31	2	4	37
25—36	47	17	0	64	42	9	3	54
37—48	1	4	0	5	2	5	0	7
Total	204	27	29	260	156	18	10	184

(J. S. Shoemaker).

ORCHARD CULTURE

In 1915 a block of 24 Stayman Winesap and 24 Delicious trees was planted to be used in comparing the cost and value of trees growing under the grass mulch and under the cover crop systems of culture. From the beginning all costs and yields per tree have been carefully recorded. The 24 trees in the grass mulch section were planted in the sod. The grass grown on the plot and mulch material from outside the orchard have been used to maintain the trees under the grass mulch system. The cover crop section has been cultivated and two cover crops have been turned under annually. Since 1923 one-half of each plot has received annually a moderate amount of nitrogenous fertilizer (¼ lb. for each year of the tree's age). To date no appreciable difference in yield has been noted from the use of the fertilizer.

Some of the information on costs and yields for the 14 years is presented here.

Seven of the original Stayman trees had to be replaced because of winter injury due to improper drainage. All of the original Delicious are still in good condition, showing in this instance that the Delicious were more resistant to injury of this nature.

Notwithstanding the loss of seven trees, the total production of Stayman to date has been 799.9 bushels and that of Delicious 668.1 bushels. The value of the Stayman crop of fruit first exceeded the annual cost of production and handling in the eighth year, while Delicious did not reach profitable production until the tenth year.

The total production of Stayman on the cover crop plot to and including the 1928 crop averaged 2347.9 pounds per tree, and of the Delicious 1494.8 pounds per tree. Stayman trees on the grass mulch section have averaged 2131 pounds per tree and Delicious 1169.5 pounds, thus showing an advantage for the cover crop plot in each variety.

The cost of maintenance has been lower in the grass mulch section and the cost per bushel in the cover crop section. Assuming that both plots had suffered the same losses in trees due to winter injury, the cost per bushel for the entire period 1915-1928 would have been 76 cents per bushel on the cover crop plot and 82 cents per bushel on the grass mulch plot.

These costs are based on maintenance charges over the 14-year period, including charges for materials, labor, supervision, taxes, interest, harvesting, and grading.

Excluding the cost of development during the first nine years and considering only the annual expenses for the last five years, when production has been highest, the cost per bushel for this period on the cover crop plot was 54.5 cents and on the grass mulch plot 64.8 cents.

No significant difference in either color or quality has been noted.

At the Hamilton County Experiment Farm an orchard of Grimes Golden and Jonathan was planted in 1912. The average yield for the 6-year period from 1922 to 1927 is as follows:

Average per tree per year of all trees in mulch, 219 pounds
Average per tree per year of all trees in tillage, 200 pounds

At the Clermont County Experiment Farm a seven-year average shows the following yield per tree:

Grass mulch	246 pounds
Tillage-cover crop	222 pounds

The Station has advocated both tillage and mulch as suitable systems of orchard managment. In many places tillage is out of the question because of the topography of the land. In some places mulch has proved the most economical system and in others, as the one cited above, tillage has been the more profitable because of the increased production. It is largely a question of proper adaptation to the conditions under which an orchard must be developed.

(C. W. Ellenwood and F. H. Ballou).

Effect of Cultural Treatment on Nitrate Content of Soil

	Soil nitrates p.p.m. 3-year average
Beneath trees standing in sod	3.90
Beneath tilled trees	7.71
Beneath straw-mulched trees	8.39

(J. H. Gourley).

FERTILIZERS IN THE ORCHARD

From experiments conducted during the past 20 years it has been shown that nitrogen is the most essential element for orchard fertilization. For the benefit of the grass cover or the intercrop it is advisable to use superphosphate between the tree rows. The nitrogen is usually applied beneath the branches but frequently it would be beneficial to apply it over the entire orchard area. The

usual rate of nitrogen application is ¼ pound of nitrate of soda for each year of the tree's age. Sulfate of ammonia has proved equally beneficial.

Effect of Nitrogen in the Station Orchard

(The same actual amount of nitrogen to each tree)

	1925	1926	1927	1928	Average
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*
Sulfate of ammonia	834	3501	1966	1337	1910
No treatment	213	662	1124	124	531
Sulfate of ammonia in two applications	1173	1870	3282	638	1741
Nitrate of soda in two applications	498	1479	4295	670	1735

7-Year Average Yields Per Tree in Orchard at Clermont County Experiment Farm

	Grass mulch section	Annually tilled section
	Lb.	*Lb.*
Fertilized with sulfate of ammonia	323	326
Fertilized with nitrate of soda	304	275
Unfertilized	111	87

Fertilizing the Peach, Yule Orchard, Danbury, Ohio

	1925	1926	1927	Average
	Lb.	*Lb.*	*Lb.*	*Lb.*
Sulfate of ammonia, 3 lb.	1039	1724	1090	1284
Nitrate of soda, 3.5 lb.	1079	1720	1310	1303
Complete fertilizer, 9 lb.	1240	1830	1019	1363
Tankage, 9 lb. / Bone meal, 5 lb.	809	1170	597	829
Untreated	398	423	593	471

(J. H. Gourley and F. H. Ballou).

EFFECT OF NITROGENOUS FERTILIZERS ON APPLES

This experiment in cooperation with the Chilean Nitrate of Soda Company was designed to study the effect of nitrate of soda on the color and storage quality of apples. The treatments include a triple application of nitrate of soda, nitrate and superphosphate, nitrate of soda and muriate of potash, a complete fertilizer, and no treatment except tillage. On some plots the application of nitrogen is made in April, on one it is in August, and on one in September.

Laboratory work on the fruit includes determination thruout the growing season of catalase activity, total nitrogen, pectin (calcium pectate) content, respiration rate, titratable acidity, and the pH of the flesh.

The work has not proceeded long enough to draw conclusions, but it may be stated that in the storage tests for the last three years there has been no indication that apples from Stayman Winesap trees that had been treated with either "normal" nitrate of soda or three times the normal rate decayed more quickly than those from untreated trees. Those from the highly fertilized trees were not quite so well colored and developed a small amount of scald. This scald could have been largely controlled by wrapping the fruit in oiled paper, as shown by other tests with these apples. There seems little evidence at present that there is an extensive breakdown in the storage of fruit from the use of nitrate of soda under the present practice in Ohio. (J. H. Gourley).

THINNING

Thinning has been a general practice in the Station orchards for a number of years. Early in the season some thinning is done by hand, but most operators do better work with thinning shears. The average workman removes 450 to 500 apples per hour on well laden trees where a ladder is required. Faster work is done on young trees where the bulk of thinning may be done from the ground.

Without attempting to set forth detailed results, it may be said that thinning must often be accepted as a necessary orchard practice. Reduced breakage of overladen trees, improved size, quality, and color are some of the results from thinning.

Baldwin Thinned to 4, 8, and 12 Inches

	Before thinning	After thinning	Yield of 1st	Yield of 2d	1st per 50 lb.	2d per 50 lb.
	No.	*No.*	*Bu.*	*Bu.*	*No.*	*No.*
Unthinned	7,427	7,427	5.0	13	275	500
8 inches	8,805	5,253	14.7	7.5	220	390
8 inches	5,853	3,747	9.7	3.5	215	415
Unthinned	3,720	3,720	1.5	7.0	280	485
8 inches	4,896	2,856	6.0	4.0	230	425
Unthinned	7,156	7,156	17.0	7.0	225	400
8 inches	8,089	5,311	21.0	3.0	200	375
12 inches	7,086	4,068	19.0	1.5	175	360
Unthinned	9,394	9,394	7.0	14.5	285	500
4 inches	10,225	7,315	8.2	13.3	255	390

The degree of thinning is so related to variety, pruning, and local market that it is not possible to make definite recommendations concerning distances. As a general rule apples are thinned so that the fruits are 8 to 10 inches apart on the tree. This distance will usually give about the proper balance between the number of

leaves and remaining fruit for the best results. The best results are obtained by thinning within a month after the June drop.

(C. W. Ellenwood).

FRUIT SETTING IN THE APPLE

STAYMAN WINESAP

Stayman Winesap under normal conditions has a very heavy first drop and a light second drop. After the first drop the fruit bearing clusters usually average only one fruit. The percentages given are those obtained under conditions of no frost injury, adequate pollination, and good vigor.

Open Pollinated Set of Stayman Winesap Flowers, 1925-1929

Year	Number of trees	Number of flowers counted	Percentage of flowers setting fruit after first drop
1925	3	2,139	9.5
1926	11	10,535	13.4
1927	7	17,677	22.2
1928	2	14,949	11.9
1929	12	13,082	10.6
Total and average	35	58,382	14.9

If only one fruit on the average had set to a cluster after the first drop, the set would have been 20 percent. Following the second drop, the percent set was still lower. These trees with a few exceptions had satisfactory commercial crops, since Stayman Winesap produces an abundance of flowers. One fruit to every third flowering spur is about sufficient.

Pollination of Stayman Winesap, Wooster, 1929

Pollen variety	Number of flowers	Percentage of flowers setting fruit	
		After 1st drop	After 2d drop
Stayman	370	2.2	0.5
Delicious	153	20.7	15.7
Gallia Beauty	69	23.2	13.0
Grimes	99	16.1	12.1
Jonathan	202	16.3	12.9

Stayman Winesap flowers are more susceptible to frost injury than Grimes Golden and Jonathan. Frosts after bloom are more serious with this variety than those occurring before bloom.

Stayman Winesap is not sufficiently self-fruitful for a commercial crop. The results in 1929 indicate this. The data also indicate several effective pollinizing varieties.

Investigations at the Station have also indicated that Ensee, Gallia Beauty, Golden Delicious, Rome Beauty, Yellow Transparent, and York are effective pollinizing varieties for Stayman Winesap.

In view of the normal heavy first drop, trees of Stayman Winesap must be kept vigorous for satisfactory commercial crops.

Effect of Vigor on Fruit Setting in Stayman Winesap, 1925 and 1929

Treatment	Year	Number of trees	Age	Percent set
Nitrate of soda	1925	2	9	10.4
No fertilizer	1925	2	9	4.7
Nitrate of soda	1929	1	13	4.1
No fertilizer	1929	1	13	1.0

Effect of Vigor on Set in Stayman Winesap, 1926

Treatment	Percentage of flowers setting fruit	Percentage of clusters without fruits
Sod, nitrate soda, 12 lb	15.5	28.6
Sod, nitrate soda, 6 lb	18.7	17.1
Cultivation, nitrate soda, 3 lb	15.0	26.4
Cultivation, no fertilizer	15.8	59.9
Grass mulch, nitrate soda, 5 lb	12.5	40.0
Grass mulch, no fertilizer	14.6	27.3
Sod, nitrate soda, 2½ lb	12.7	61.3
Sod, nitrate soda, 2½ lb	6.2	65.0
Sod, no fertilizer	2.8	88.0
Sod, no fertilizer	8.2	63.2
Sod, no fertilizer	8.6	61.5

The trees in sod with only 2½ pounds nitrate of soda and those receiving no fertilizer showed distinct evidences of lack of sufficient nitrogen for growth and fruit setting.

Trees of Stayman Winesap during their first years of flowering tend to drop their flowers. Good cultural practices should be continued.

RECOMMENDATIONS FOR STAYMAN WINESAP

(1) Maintain as high vigor as is possible without sacrificing color of fruit.
   (a) Give the trees an annual dormant, well distributed, thinning out pruning.
   (b) Fertilize with nitrogenous fertilizer 2 to 3 weeks before bloom.

(2) Provide for effective pollination.
   (a) Keep bees in the orchard.
   (b) Have pollinizing varieties intermixed or in adjacent rows.

DELICIOUS

Delicious under normal conditions has a heavy first drop of flowers and partially developed fruits. There is also considerable irregularity in the fruit setting on different limbs of the same tree. Many clusters have no fruit, and the average is only one fruit to a cluster. This is shown by well pollinated trees in the Station orchards.

Set of Open Pollinated Flowers of Delicious, Wooster, 1925-1929

Year	Number of trees	Number of flowers counted	Percentage set after 1st drop
1925	3	1,955	8.8
1926	1	492	12.6
1927	6	15,838	14.6
1928	3	3,795	16.9
1929	6	8,035	13.3

If the clusters averaged one fruit each, the set would be 20 percent. The second drop normally is light. If abnormally heavy, as in the Culture Orchard in 1929, the commercial crop will be reduced considerably. Delicious is not as abundant a flower producer as Stayman.

Pollination of Delicious, Wooster, 1925 and 1929

Pollen variety	Number of flowers	Percentage set after first drop
McIntosh, 1925	106	23.6
Delicious, 1929	786	.5
Gallia Beauty, 1929	142	46.5
Grimes Golden, 1929	86	77.9
Jonathan, 1929	130	30.0

Delicious flowers are more susceptible to frost injury than those of other commercial varieties grown in Ohio. Like Stayman, frosts after bloom are more disastrous than those before bloom.

Delicious is not sufficiently self-fruitful for a commercial crop.

Investigations at this and other stations indicate that Yellow Transparent, Gano, Golden Delicious, Rome Beauty, and York Imperial are also effective in pollinizing Delicious. Richared and Starking are of no value.

The maintenance of as high vigor as is possible without sacrificing color is necessary for maximum fruit setting on bearing trees of Delicious. This fact is supported by the percentages of set obtained in the tops of trees whose flowers have not been injured by frost as well as by those obtained from hand pollinated

flowers. In 1927 and 1928 varying numbers of flowers were pollinated in individual clusters in order to measure the effect of the number of flowers present in a cluster on their ability to set.

Effect of Reduction on Number of Flowers on Fruit Set
Wooster, 1928

Number of flowers to a cluster (all laterals)	Percentage set	
	After 1st drop	After 2d drop
1	42.7	34.8
2	29.3	27.7
3	16.9	14.5
4	14.4	12.0

The results from both years show that there is a decided competition among the flowers resulting in considerably higher sets where only one and two flowers are left. Since the grower cannot reduce the number of flowers to a cluster his alternative is to make certain that flowering trees have plenty of nutritive materials. This is done by carrying out good cultural practices, such as adequate pruning and fertilization.

Recommendations for maximum fruit setting are the same recommendations as for Stayman.

JONATHAN

Jonathan, under normal conditions, has an average of three or more fruits to a cluster after the first wave of dropping. The severity of the June drop depends in large part on the vigor of the tree. Following a very heavy blooming and a heavy first set the June drop will tend to be heavy.

Pollination of Jonathan, Wooster, 1928 and 1929

Pollen variety	Tree No.	Flowers pollinated	Percentage set		
			After 1st drop	After 2d drop	After thinning
Jonathan, 1928	408—9	662	5.6	2.9	.....
Open set, 1928	408—9	1,679	34.7	11.3	8.8
Jonathan, 1929	408—7	908	0.3	0	0
Gallia Beauty, 1929	408—7	604	31.4	10.9	8.4
Open set, 1929	408—7	1,520	31.4	4.3	4.3

Jonathan is not as susceptible to frost as Stayman and Delicious and probably Grimes Golden. The necessity of cross pollination is indicated by further results obtained in 1928 and 1929.

GRIMES GOLDEN

Grimes Golden under normal conditions, like Jonathan, has a heavy set after the first drop. On trees of medium or low vigor the June drop may be heavy. Unless the factors affecting fruit setting are very unfavorable Grimes Golden will have a satisfactory commercial crop. The necessity of cross pollination is indicated by further results obtained in 1929.

Pollination of Grimes Golden, Wooster, 1929

Pollen variety	Tree No.	Flowers pollinated	Percentage set		
			After 1st drop	After 2d drop	After thinning
Grimes Golden	410—9	671	1.7	1.0	.....
Jonathan	410—9	119	72.3	30.9	24.8
Open set	410—9	1,662	62.6	18.9	13.8

ROME BEAUTY AND GALLIA BEAUTY

Rome Beauty under normal conditions has a very heavy first set. This is often followed on trees of medium vigor by a rather severe June drop.

Pollination of Rome Beauty, Wooster, 1928 and 1929

Pollen variety	Tree No.	Number of flowers pollinated	Percentage set		
			After 1st drop	After 2d drop	After thinning
Rome Beauty, 1928	430	500	19.2	8.0	7.4
Gallia Beauty, 1928	430	306	0	0	0
Open set, 1928	430	451	.....	12.4	11.1
Rome, 1929	425	651	2.0	1.7	1.7
Golden Delicious, 1929	425	105	41.9	16.2	16.2
Open set, 1929	425	791	20.8	4.7	4.7

The late blooming of the variety often enables it to survive frosts with a commercial crop. The variety, from experiments at this Station, appears to have a higher degree of self-fruitfulness than any other commercial variety except Gallia Beauty. It does not appear, however, to be sufficiently self-fruitful for full commercial crops. This is indicated by further pollination results in 1928 and 1929.

Gallia Beauty like Rome is partially self-fruitful. It requires cross pollination for full crops.

Pollination of Gallia Beauty, Wooster, 1929

Pollen variety	Tree No.	Number of flowers pollinated	Percentage set		
			After 1st drop	After 2d drop	After thinning
Gallia Beauty	4	366	18.0	8.2	8.2
Rome	4	287	6.6	0.7	.....
Red Spy	4	197	44.1	16.7	.....
Jonathan	4	154	28.5	13.6	.....
Open set	4	481	43.0	15.6	12.1

BALDWIN

Baldwin under normal conditions, like Jonathan and Grimes, has a heavy first set. Consequently the June drop may be heavy unless the vigor of the tree is high.

Pollination of Baldwin, Wooster, 1927-1929

Pollen variety	Tree No.	Flowers pollinated	Percentage set		
			After 1st drop	After 2d drop	After thinning
Baldwin, 1927	117	410	22.7	5.4	5.3
Delicious, 1927	117	513	84.4	61.9	.....
Open set, 1927	117	2,529	17.8	11.6	7.1
Baldwin, 1927	119	480	16.2	5.2	5.2
Delicious, 1927	119	154	64.9	30.5	.....
Open set, 1927	119	664	17.2	8.8	7.1
Baldwin, 1928	359	162	3.7	1.9	1.9
Jonathan, 1928	359	347	24.5	7.0	.....
Open set, 1928	359	1,129	44.2	11.1	8.1
Baldwin, 1929	359	208	5.8	1.4	1.4
Jonathan, 1929	359	77	45.4	26.0	.....
Open set, 1929	359	1,901	42.3	11.9	8.9
Baldwin, 1929	8-4	289	0	0	0
Jonathan, 1929	8-4	272	.....	18.7	.....
Open set, 1929	8-4	976	.....	1.7	1.7
Baldwin, 1929	8-3	290	1.8	0.7	0.7
Open set, 1929	8-3	760	11.2	4.7	4.7

Baldwin does not appear to be any more susceptible to frost than Grimes Golden, Jonathan, and McIntosh. The inability of Baldwin to produce commercial crops without cross pollination is further indicated by the results of 1927-1929. (F. S. Howlett).

EFFECT OF LIME-SULFUR ON FRUIT DROPPING WHEN THE FOLIAGE WAS NOT INJURED

Experiments were conducted jointly by the departments of horticulture and plant pathology in 1927 and 1928 to determine whether lime-sulfur solutions applied at the 2 to 3 weeks spray caused fruit dropping in Ensee and Grimes Golden when there were

no visible marks of spray injury upon the fruits or the foliage. Lime-sulfur solution 1 to 60 slightly reduced the set on Ensee and Grimes while the dilution 1 to 100 or greater had no effect. The loss of fruit due to the dilutions of 1 to 40 and 1 to 60 or greater was not sufficient to affect the normally heavy crop of these varieties. (F. S. Howlett and Curtis May).

EFFECT OF EARLY THINNING ON JUNE DROP

The importance of the competition for food materials among the partially developed fruits as the most important factor influencing the severity of the late drop is indicated by some results obtained with Grimes. The numbers of fruits on individual clusters were reduced to varying numbers as soon as there was sufficient enlargement to distinguish the sets from first drops. This was just before the 2 to 3 weeks spray.

Effect of Number of Fruits in a Cluster on June Drop

Number of fruits in a cluster	Percentage of these fruits falling in June drop			Average number of fruits per 100 fruit bearing clusters after June drop		
	1926	1927	1928	1926	1927	1928
1	.....	19.5	8.3	.....	81	92
2	.....	37.5	42.8	.....	125	114
3	72.6	.....	54.8	81	.....	135
4	80.5	68.4	.....	98	126	.....
5	88.1	.....	.....	60	.....	.....

In 1927, 81 percent and in 1928, 92 percent of the single fruits remained in the cluster thru the June drop.

These results are significant in determining whether it would be wise to thin a heavy setting summer or fall variety, such as Yellow Transparent, before the June drop to enable large sized fruits to develop. Yellow Transparent usually has 85 or more percent of its clusters bearing fruit thru the first drop. Thinning to one fruit reduces the June drop to such an extent that full commercial crops would still be obtained provided a slightly larger number of clusters were left with one fruit in the pre-June drop thinning than in thinning after the June drop. (F. S. Howlett).

RINGING FILLER APPLE TREES

Cutting out or peeling off a narrow ring of bark is termed ringing. The object is to secure a temporary cessation in the downward translocation of plant food, which frequently results in fruit bud formation for the ensuing year. The time usually recommended for the operation is the latter part of May or early June. This will insure rapid healing of the wound.

Trees in a vigorous condition developed a normal set of fruit. The size, flavor, and keeping quality was not affected by the practice.

Since the experiments conducted have demonstrated that tardy bearing apple trees can be brought into fruiting by ringing and without injury to the trees, the practice is recommended for filler trees or special conditions. (J. H. Gourley and F. S. Howlett).

SPRAYING AND DUSTING EXPERIMENTS FOR THE SEASON OF 1928

During the last three years there have been at least three outstanding object lessons from this spraying work.

First, even in case of varieties of apples readily susceptible to infection by scab, timely, careful, thoro use of dependable sprays of moderate concentration in the pre-bloom stages of fruit-bud development, and, perhaps with certain exceptions, sprays of modified or more dilute form for after-bloom applications have afforded under even very unfavorable topographic, climatic and seasonal conditions, the maximum of protection against scab.

Results of Spraying and Dusting Rome Beauty Apples

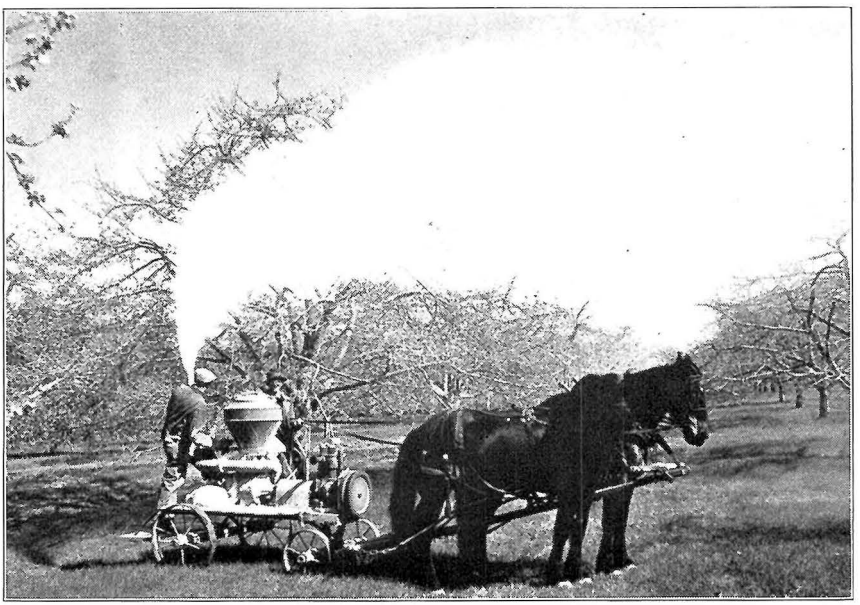
Orchard and application	Wholly free from scab Pct.	Very slightly scabbed Pct.	Commercially free from scab Pct.
Rome Beauty–Dusted, 1928			
Belmont County; dusted 8 times 80–20 sulfur-lime and 80–10–10 sulfur-lime-lead	73.9	17.6	91.5
Licking County; dusted 6 times 80–20 sulfur-lime and 80–10–10 sulfur-lime-lead	80.5	13.7	94.2
Meigs County; dusted 7 times 80–20 sulfur-lime and 80–10–10 sulfur-lime lead	91.9	6.3	98.2
Washington County; dusted 6 times 80–20 sulfur-lime and 80–10–10 sulfur-lime-lead	68.2	25.9	94.1
Average for the four counties	78.6	15.8	94.5
Rome Beauty–Sprayed, 1928			
Belmont County; sprayed 6 times 3–5–50 and 1½–5–50 dry lime-sulfur hydrated lime.	72.5	21.4	93.9
Licking County; sprayed 4 times 3–5–50 and 1½–5–50 dry lime-sulfur hydrated lime.	84.1	11.0	95.1
Meigs County; sprayed 5 times 3–5–50 and 1½–5–5 lime-sulfur, dry hydrated lime.	95.0	2.9	97.9
Washington County; sprayed 7 times 3–5–50 and 1½–5–50 dry lime-sulfur hydrated lime.	80.2	16.5	96.7
Average for the four counties	82.9	12.9	95.8
Rome Beauty Checks, 1928			
Belmont County; no dusting or spraying	2.0	13.2	None salable
Licking County; no dusting or spraying	2.7	23.5	None salable
Meigs County; no checks left in 1928	.....	.....	.....
Washington County; no dusting or spraying	0	5.4	None salable
Washington County; pre-bloom dust only (80–20)	53.6	31.8	85.5
Washington County; petal fall spray only (1½–5–50)	8.0	40.8	48.8

Second, is that, even with varieties particularly subject to this disease, equally timely, careful, thoro work in dusting apple orchards with formulas containing from 80 to 90 percent of superfine sulfur, has afforded, likewise, almost if not quite as great a degree of protection from scab infection as has spraying.

Third object lesson is that under naturally propitious conditions for production of apples, it is readily and safely possible to make use of modified or dilute spray formulas following the period of apple bloom. (F. H. Ballou and I. P. Lewis).

SOME SPRAYING AND DUSTING COSTS FOR 1929

Factors, such as cost and capacity of equipment, convenience of water supply, freight on spray materials, and efficiency of the operator, are so variable that these differences must be kept in mind in considering the cost of spraying and dusting.



Dusting Station Orchards, 1929

The costs are calculated on the current prices of material and labor at Wooster for 1929. It is well to note, however, that these prices have remained practically the same for the last five years, being higher in a few instances and lower in others.

Labor has been calculated at 40 cents per hour, team labor at 35 cents per hour; the use of sprayer or duster including fuel at 85 cents per hour. Working 9½ hours it has been possible to average 1800 gallons of solution per day. Dust has been applied at the average rate of 125 pounds per hour. The sprayer used has been in operation five years, and is of moderate capacity, supplying 375 pounds pressure for two spray guns. On the basis of the charges made the cost in 1929 of applying solution was $0.0126 per gallon and of applying dust $0.016 per pound.

Spray Solution Used Per Tree for Each Application in Apple Orchards of Three Different Ages

Age of trees, years	Pre-bloom sprays	After bloom sprays
	Gal.	*Gal.*
8	3.1	4.8
15	11.8	16.7
36	24.0	28.3

Because weather conditions were favorable for the development of disease and insect pests, the quantity of spray material used this year was slightly higher than the average, but it closely approximates the amounts which experience has shown necessary for good coverage.

Cost Per Gallon of Some Standard Spray Solutions and Cost of Application

Material	Cost of solution and application, per gallon
Oil emulsion (Sunoco 1-25)	$0.028
Oil emulsion (Rex 1-33⅓)	.021
Liquid lime-sulfur (Grasselli 6-50)	.034
Liquid lime-sulfur (Grasselli 1-40)	.017
Liquid lime-sulfur (Grasselli 1-80)	.015
Dry lime-sulfur (Sherwin-Williams 12-50)	.032
Dry lime-sulfur (Sherwin-Williams 3-50)	.017
Dry lime-sulfur (Sherwin-Williams 2-50)	.016

The addition of arsenate of lead 2½-100 increased the cost $0.003 per gallon of solution. Black leaf 40, when used at the rate of 1 to 800, added $0.013 per gallon to the cost.

In an orchard of approximately 200 trees 27 years old which was dusted 11 times this season, following a dormant application of oil emulsion, the cost for dusting and the dormant application of oil was $1.83 per tree, or a little less than it would have cost to have sprayed the trees 6 times.

The dust used in this orchard was a 90-10 sulfur-lime dust and where arsenate was used was 80-10-10. (C. W. Ellenwood).

VALUE OF APPLE WRAPS

For two years, tests have been conducted in a common storage to determine the value of shredded oil paper, oil wraps, and plain wraps in preserving fruit, compared with unwrapped fruit, both in baskets and open crates. Golden Delicious, Jonathan, and Stayman were the varieties under test.

Shrivelling and decay were greatly reduced and the finish of the fruit improved where either oil wraps or shredded oil paper was used as compared with unwrapped fruit.

The cost per bushel basket for oil wrappers used in 1928 was 6½ to 8 cents and for shredded oil paper about 4 cents.

It is important to have good quality oiled paper or oiled wraps rather than a waxed or parafined paper. Whether the additional cost would pay depends upon the variety, the length of time the fruit is to be held in storage, and whether the market will pay a premium for the superior quality due to wrapping.

For Golden Delicious that are to be held in storage beyond the first of January the experiment indicated that it is advisable either to wrap them or to store them in shredded oil paper. Golden Delicious and, to some extent, other varieties are apt to shrivel where they touch an exceptionally dry wood container. For this reason liners tend to reduce shrivelling where the fruit is not wrapped. (C. W. Ellenwood).

RUNNER STUDIES WITH HOWARD 17 (PREMIER) STRAWBERRY

Howard 17 (Premier), the leading strawberry variety in the State, sometimes has not been as prolific a plant maker as could be desired. In 1928 records were kept of 37,252 runners. Of this total, 387 runners or 1.4 percent rooted in June; 6,568, or 17.6 percent, rooted in July; 10,310, or 27.6 percent, rooted in August, 2,602, or 6.8 percent, rooted between September 1 and October 15; and 17,384, or 46.6 percent, were formed but only a small percentage rooted after October 15. Altho the percentage of runners rooting in June was small, the accompanying table shows a correlation between number of runners rooted in June and at later periods. This serves to emphasize the importance of getting the plants off to a good start; early planting, well prepared soil, and good plants are very important in this respect. Further work was conducted with

these plants in 1929 to determine whether early runners are more productive than later ones. The same bed was also used for an extensive experiment with nitrogenous fertilizer.

Number Runners Rooted in June in Relation to Number Later Runners

Number runners rooted in June per row of 15 parent plants	Number runners rooted						Ratio	
	July	Aug.	Sept.-Oct. 15	Oct. 15 Nov.*	Total		Runners per parent plant	
					Oct. 15	Season*	Oct. 15	Season*
0- 1	53	77	21	176	152	328	10:1	22:1
2- 3	62	86	21	186	172	358	11:1	24:1
4- 5	71	124	29	170	227	397	15:1	26:1
6- 7	77	123	31	176	238	403	16:1	27:1
8- 9	73	140	34	163	255	418	17:1	28:1
10-12	96	120	46	153	274	427	18:1	29:1

*These columns include runners formed, few rooting after October 15.

(J. S. Shoemaker).

TIP LAYERING THE BLACK RASPBERRY

A number of phases of tip layering the black raspberry have been studied. The best time for layering is when the tip portion has lengthened out in "snaky" or "rat-tail" fashion with small curled leaves; usually beginning about mid-August in the southern part of the State and in early September in the northern part. Tips put down too early are likely to push out of the ground and in such a case can again be tipped, altho plants secured in this way are not the best. Tipping too late may result in several small plants from sub-laterals instead of one new plant with a well developed root system from each lateral. The use of small plants in setting led to only about 25 percent stand and loss of practically a year in comparison with an almost perfect stand and thrifty growth from plants with well developed root systems.

Three or four inches of soil made a satisfactory covering. Shallow tipping may result in considerable loss from whipping, heaving, or pushing out of the soil. Too deep tipping may result in breakage of many of the tender sprouts in digging. A vertical rather than a horizontal position of the tips in the ground is much to be preferred.

Plants with best root systems are obtained when only one tip is put down from each lateral. In a good black raspberry plantation more than 10,000 laterals for tipping are expected per acre.

There is great tendency for laterals to branch just before rooting, resulting in a whorled type of sub-lateral development. With such a condition the plants obtained, altho increasing the number, are usually smaller and do not possess the extensive root systems secured when unbranched laterals are tipped. Sometimes the sub-laterals are long enough so that the plants develop fairly good root systems, but on the whole, sub-lateral growth is not desirable.

Sub-lateral growth frequently results from bruising of the tips where the main laterals touch the ground, thru whipping by wind. A late summer-sown cover crop, such as oats, which forms a mat, does not become too high, winter-kills, and does not interfere with digging in the spring, may be worthy of trial under some conditions to prevent bruising of the tips. (J. S. Shoemaker).

POTATOES

VARIETIES AND SOURCES OF CERTIFIED SEED POTATOES

Of the early varieties, the Irish Cobbler is rapidly supplanting the Early Ohio. Certified Irish Cobbler seed from Prince Edward Island, New York, or Michigan has outyielded the Early Ohio from Minnesota. The Irish Cobbler samples tested to date have all been of excellent quality.

Of the late varieties, the Russet Rural has given the highest average yield during five years of comparative tests. Certified samples from Michigan have shown less disease than samples from New York or Ohio. The Smooth (or White) Rural has in some instances equalled the Russet Rural, but not consistently over a period of years. (John Bushnell).

HOME-GROWN SEED POTATOES

Frequently Ohio-grown seed potatoes, one year from certified, yield as well as or even better than certified seed from the same original source. It is clear from these tests that under some conditions very excellent seed is produced in Ohio. These special conditions are: (1) an original certified seed with a very low percentage of degeneration disease, (2) planted some distance from any diseased potatoes, (3) planted late, and (4) stored properly.

(John Bushnell).

IMMATURE VERSUS MATURE SEED POTATOES

Mature seed potatoes produce more sprouts and germinate more rapidly than immature seed. The number of eyes on the piece has but little effect; one eye may produce several sprouts. Immature seed gives more vigorous sprouts, tho slower growing, and usually outyields mature seed. Comparative yields from a planting May 24, 1927 were:

Mature seed	241 pounds
Immature seed	266 pounds

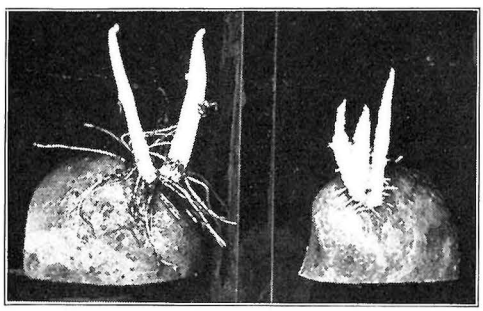
Seed potatoes to be of highest productivity, therefore, should be from late plantings and be immature at the close of the growing season. Such seed being slow to sprout keeps well in storage.

Mature **Immature**

Characteristic difference in sprouting from mature and immature tubers planted in May

DATE OF PLANTING AND CHARACTER OF SPROUTING OF POTATOES

Late varieties, such as the Russet Rural, if planted in early April produce one or two sturdy sprouts from each piece. Planted in May, two or three sprouts develop; planted in June, three or four. The gradual increase in number of sprouts is due to internal changes taking place in the seed tubers during storage. The longer the storage, the larger the number of sprouts.



In early April **In late May**

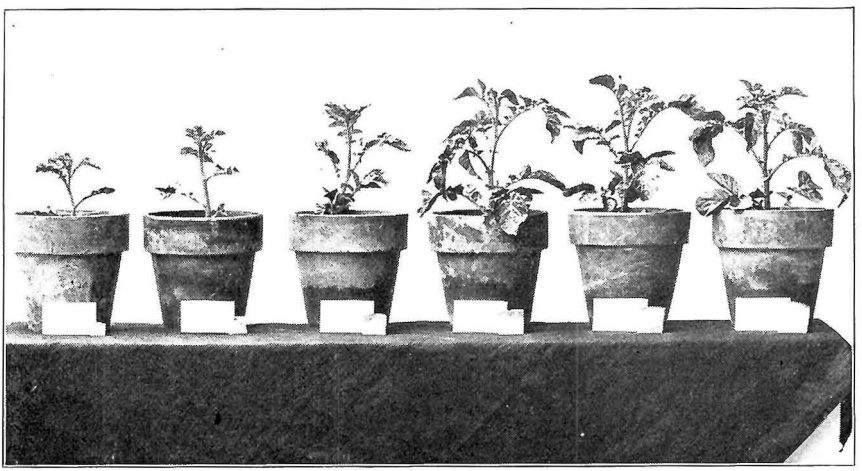
Sprout development during two weeks in incubator at 68°

As the number of sprouts increases, there is a parallel decrease in the vigor of the individual sprouts. Planting two-ounce pieces in an incubator at a temperature of 68° at intervals of two weeks showed that the largest sprouts developed on April plantings.

Field experiments have in some seasons given the highest yields from April plantings of Russet Rural, but in more instances late May plantings, even tho the sprouts were weaker, gave the higher yields. This is explained by the fact that late May plantings usually encounter more favorable weather, growing as they do thru the cool of the fall. (John Bushnell).

SIZE OF POTATO SEED PIECE

Seed pieces weighing less than three-fourths ounce are insufficient to support sturdy sprouts. During the ordinary planting season, pieces larger than ¾ ounce produce two or more sprouts, the number increasing with the weight of the piece.



⅛ oz. ¼ oz. ½ oz. ¾ oz. 1 oz. 1½ oz.

Sprouts from seed pieces of different size

To economically obtain the largest number of vigorous sprouts from a bushel of seed potatoes, the seed is cut into the minimum size pieces. In practice the aim is to have no pieces smaller than ¾ ounce; the average weight will be about one ounce. In a planting May 1, 100 one-ounce pieces produced 125 sturdy sprouts, that is, 25 of the pieces produced two sprouts. The same number of two-ounce pieces in the row produced 175 sprouts. By spacing the one-ounce pieces 9 inches in the row, essentially the same number of sprouts were produced by 20 bushels of seed per acre as from 30

bushels cut into two-ounce pieces spaced 12 inches apart. The difference in yield was less than the difference in the amount of seed required.

Economy in Small Pieces Properly Spaced

Seed pieces ounces	Between hills inches	Number of sprouts per 100 feet of row	Yield per acre bushels
1	9	167	238
2	12	175	243

(John Bushnell).

SOIL REACTION FOR POTATOES

Liming is not recommended for potatoes, chiefly because of the danger of increasing the prevalence of scab. With legumes in a rotation acid soils are usually limed to insure a large crop of green manure.

A two-year rotation of potatoes and soybeans has been limed at varying rates. The soybeans are plowed under while green. A 4-10-6 fertilizer is applied at the rate of 2,000 pounds per acre to the potatoes. The soil reaction varies from pH 5 to 7.5. The highest yield in 1928 was from the plot with pH about 6. Scab was not serious. Care has been used so far to avoid infection with scab from the seed. The soybeans were larger on the plots nearly neutral than on the more acid plots, which may in part account for the results.

pH	Yield
5.0	254
5.5	266
6.0	283
7.0	276
7.5	256

(John Bushnell).

STRAW MULCH FOR POTATOES

Straw mulch has not given consistent nor large returns upon late potatoes at Wooster. On early potatoes at the Hamilton County farm, a mulch applied immediately after planting was detrimental. By delaying the mulch until the plants were up and the soil warm, the yield was increased from 135 bushels per acre from cultivation to 166 bushels on the mulched plot.

The cost of the straw and the labor involved in removing it are so great as to make mulching impractical as a general practice.

(John Bushnell).

GREENHOUSE

MULCHING TOMATOES UNDER GLASS

When tomatoes are mulched with such materials as well rotted manure, fresh strawy manure, manure with wood shavings, straw, dried tobacco stems, steamed garbage, and chopped corn stover, very marked injury is observed. The mulches retard the growth of the plants, delay the setting and maturity of the fruits, and reduce the yield.

The Effect of Manure Mulch Upon the Ripening of Tomatoes

Treatment	Yield May 3 to May 15	Decrease due to treatment
	Lb.	*Pct.*
Unmulched	13.5	
Mulched	11.7	13.3
Mulch and sulfate of ammonia	12.5	7.4

The retarding effect starts in almost as soon as the mulch is applied. The early fruits are delayed in ripening, as is shown by the following table. Altho a good grade of cattle manure was used in this test, the effect is striking. (I. C. Hoffman).

LEAF PRUNING

Leaf pruning, that is, removing live, healthy, green leaves from the base of the plant before the fruits have become developed in the adjacent clusters, tends to reduce the size of the fruits, delay ripening, and retard the later growth of the plants. The total yield is decreased according to the amount of leaf surface removed.

Leaf Pruning in Tomatoes

Treatment	Average size of fruits	Yield per plant	Loss due to treatment
	Oz.	*Lb.*	*Pct.*
Unmulched	6.24	10.28	
Leaves tipped below first cluster	5.89	9.62	6.42
Leaves pruned off below first cluster	5.98	9.51	7.50
Leaves pruned off below second cluster	5.86	8.41	18.19

(I. C. Hoffman).

TIME OF SOWING TOMATO SEED FOR THE SPRING CROP

Experiments show that it is possible to produce more early fruit as well as a greater total yield of tomatoes from plants started early in December than from plants started a month later.

Time of Sowing Tomato Seed

Date of sowing	Date set	First picking	Last picking	Picking season	Average yield per plant	Difference
Dec. 3–27	Feb. 4–28	May 17	July 31	66 days	10.63 lb.	2.23 lb. or 26.5%
Jan. 3–28	Feb. 18–28	June 17	July 31	56 days	8.4 lb.	.....

(I. C. Hoffman.)

FEEDING GREENHOUSE TOMATOES

It is common observation that the last tomato fruits on the tops of the vines in greenhouses are seldom as good as those produced on the lower clusters. Recent experiments have shown that in most cases this reduction in quality is due to a deficiency in one or more of the essential elements. Insufficient quantities of nitrogen, phosphorus, or potash, in particular, result in stunted plants and in thin-walled, flat-sided, light weight fruits of poor quality and flavor. When these deficiencies are corrected the plants resume normal growth and a marked improvement in the fruit results.

After a crop is planted it is difficult to apply phosphorus and potash to soils so that the crop will receive much benefit. They should be carefully mixed with the soil while it is being prepared. Nitrogen can be applied at any time. Since nitrogen is easily lost by leaching with water and a large amount of it in the soil is a distinct disadvantage in growing early tomatoes in the greenhouse, it is better to apply it as a topdressing to the plants as needed than to apply it all at once.

Several experiments show that nitrogen usually becomes deficient in greenhouse soils long before a full crop is matured. The symptoms of nitrogen shortage are spindling growth in the tops of the plants accompanied by the fading of the normal green color to a greenish-yellow or yellow. Growth declines and often the buds drop without opening or setting fruit. This condition may be corrected by applying some quickly soluble nitrogen carrier, as nitrate of soda, sulfate of ammonia, or urea, around the plants and watering it in. The normal color reappears in about a week and the plants and fruits resume their normal growth. High yields of excellent fruit can be obtained by continuing this feeding at intervals of a week or ten days until the fruits on the top cluster are about half grown. Increases in yield amounting to as much as 25 to 30 percent have been obtained following regular applications of nitrate of soda or sulfate of ammonia each week for the growing period after first two or three clusters have set. (I. C. Hoffman).

VEGETABLES

FERTILIZER EXPERIMENTS AT MARIETTA

Fertilizer experiments on a rotation of tomatoes, cabbage, cucumbers, and sweet corn are now in their 15th year and the following observations have been made.

TOMATOES

Manure has given higher yields of tomatoes than any of the chemical fertilizers, but the chemicals have been more profitable. Superphosphate has been essential and has increased the yield, particularly of early fruit. This experiment has proved the value of supplementing manure with superphosphate. Its importance and low cost warrant a liberal application for tomatoes.

The treatment of Plot 6, 1220 pounds of a 4-10-4, supplying about 50 pounds of nitrogen per acre, gave higher yields than any other combination, and nearly as good yields as the manured plots.

Very small increases were obtained from the potash applications, indicating that 100 pounds of muriate of potash annually was ample.

CABBAGE

The complete fertilizers gave much larger increases of cabbage than the manure which carried larger amounts of the fertilizing elements. It is concluded that the early crop of cabbage profited by the more quickly available nitrogen and other elements in the chemical treatments.

Nitrogen increased the yield in every instance, irrespective of the kind of fertilizer or the combination in which it was applied. Evidently cabbage requires a large amount of nitrogen, for the largest application (480 pounds of nitrate of soda) in a complete fertilizer produced the greatest increase in yield.

Only moderate amounts of superphosphate gave profitable increases on cabbage. About 1000 pounds of superphosphate per acre proved satisfactory. Small amounts of potassium failed to prove useful. However, since this element might become limiting on most soils growing cabbage, a complete fertilizer carrying 4 per-cent of potash is recommended for cabbage on most soils.

Lime was essential on acid soil for maximum yields. One ton of limestone per year on each acre for cabbage produced the largest returns per dollar invested. It is recommended that soils be limed before attempting to grow early cabbage.

CUCUMBERS

Cucumbers gave the most marked response to manure and nitrogenous fertilizers. Manure at $3.75 per ton was more profitable than the largest chemical fertilizer application. The yields indicate a very high nitrogen requirement, probably 75 pounds or more, for this crop.

Relatively small amounts of superphosphate were sufficient for the cucumber crop. An equivalent of 400 pounds per acre of 16 percent superphosphate has been recommended. Likewise potash is essential only in small quantities.

Cucumbers are not very sensitive to acid soil conditions, and no lime applications need be made unless the soil is decidedly acid.

SWEET CORN

In contrast to the other crops, sweet corn gave but small response to fertilizers, and in many cases the applications were unprofitable. Nitrogen alone gave profitable increases, especially in the form of sulfate of ammonia. Manure produced larger yields, but the low value of the crop did not justify the expenditure.

The other elements did not produce increased yields sufficient to pay for their application. Other soil conditions may give different results.

NITROGEN FERTILIZATION

Since nitrogen is the most expensive of the three principal fertilizer constituents, as well as the most important on most soils, two special studies on nitrogen were included in the experiment. Applying nitrogen after the plants were established proved to be more valuable to cabbage than to the other crops. The fact that all four crops produced as good, or better, yields from the delayed application as from the application made prior to planting may have special importance where readily soluble fertilizers are to be used in large amounts.

Neither nitrate of soda nor sulfate of ammonia was superior to the other on any of the four crops.

MAINTENANCE OF YIELDS WITHOUT MANURE

As a whole, during the first eight years yields on the experimental plots at Marietta were maintained by chemicals as well as by manure. The last four years show less encouraging results. However, with larger applications of the chemical fertilizers it is expected that yields will be maintained at a favorable level.

With manure costing $3.75 per ton, it proved profitable on cucumbers only in comparison with chemical fertilizers. A fertilizer very high in nitrogen might prove to be more economical than manure. Unless manure may be obtained at $1 per ton, it would appear more profitable to use smaller quantities of manure supplemented with light applications of chemical fertilizers.

(Donald Comin).

FERTILIZING CELERY ON MUCK

A celery fertilizer experiment comprising 12 treated plots has been in progress since 1925. The soil, a native virgin muck near Ravenna, Ohio, has responded at once to applications of commercial fertilizers.

The standard basic treatment on all plots has been 1,000 pounds per acre of a 2-8-16 fertilizer.

The largest yields were obtained from the heaviest treatment, which included two side-dressings of the same basic treatment, 2-8-16, at 3 and 6 weeks after setting the plants. It was applied at the rate of 500 pounds per side-dressing per acre. The total application was then 2,000 pounds per acre.

Reducing the topdressing to 250 pounds per acre, reduced the yield somewhat. The large increases of 11,248 and 10,036 pounds per acre, respectively, from these side-dressings, indicate the value of heavy applications of complete fertilizers on this crop. There was a steady increase in yield as the amount of fertilizer applied was increased.

Doubling either the potash or superphosphate in a 2-8-16 fertilizer increased the yields about one-tenth.

Nitrogen proved the most important single element; 400 pounds of nitrate of soda per acre as a side-dressing produced an increase of more than 8,000 pounds per acre. There was a slight advantage in an application of nitrogen delayed as late as 6 weeks after setting the plants. Sulfate of ammonia as a carrier of nitrogen proved equally as effective in increasing yields as nitrate of soda.

Eight tons of manure in addition to the basic treatment of 1,000 pounds of 2-8-16 failed to increase yields as much as an additional 500 or 1,000 pounds of the 2-8-16. The chemical equivalent of manure in the form of commercial fertilizer produced 40 percent more celery than the manure. The home-mixed fertilizer, in every case, produced as much as 10 percent more celery than the ready-mixed commercial brand used. (Donald Comin).

EARLY SWEET CORN VARIETIES

Of the 41 varieties or strains of white and 15 of yellow early sweet corn grown in the 1928 trials, the following proved to be the best when both size and earliness were considered.

Largest and Earliest Varieties of Sweet Corn in 1928 Trials

Variety	Av. weight of ears	Length	Diameter	Rows per ear	Days to 1st harvest
	Lb.	In.	In.	No.	No.
White varieties					
Earliest	0.325	5½–6½	1½	8	77
Gill's Early Market	.522	6–8	1¾–2	12	80
Early Market	.629	7–8	1½–1¾	12	80
Whipples Early	.844	7–9	1¾–2¼	16	90
Yellow varieties					
Banting	0.272	6–7	1¼	8	77
The Burpee	.408	6½–7	1¼–1¾	12	80
Golden 60 Day	.490	6–7½	1½–1¾	12	23
Sunshine	.510	7–7	1½	12	83
Whipples Yellow	.646	7–9	1½–2	12	90

(Roy Magruder).

DISTANCE OF PLANTING SWEET CORN

The distance of planting Stowells Evergreen sweet corn was tested at Wooster in 1926. The corn was harvested as for the canning factory. The largest yield per acre, 6.3 tons, was produced from rows 34 inches apart with 2 plants spaced 20 inches apart. This yield was an increase of 34 percent over that of rows 42 inches apart with 1 plant every 15 inches in the row.

An experiment with Narrow Grain Evergreen sweet corn grown at a canning factory at West Jefferson in 1928 gave similar results. The largest yield, 6.1 tons, was produced by the planting with 3-plant hills 24 inches apart in 38-inch rows. The increase in weight per acre over the usual 42 by 42-inch spacing was 73 percent. See Bimonthly Bulletin March-April, 1928, for results on Early Adams variety. (Roy Magruder).

PAPER MULCH FOR THE VEGETABLE GARDEN

Experiments with black soil-mulching paper in the vegetable garden were begun in 1924.

1. The soil temperature was raised by the mulching paper, sometimes as much as 8° F. higher than cultivated soil at a depth of 2 inches.

2. The moisture content of the upper 7 inches of paper-mulched soil was found to be higher most of the time than that of the cultivated soil.

3. No consistent difference was found in the nitrate nitrogen content of the mulched and unmulched soil.

4. The higher soil temperature and moisture of the paper-mulched area usually resulted in a better and quicker germination of seed and an earlier maturity of most of the vegetables grown.

5. No weeds grew in the areas completely covered by paper mulch.

Yield Data for Paper Mulch Garden, 1928

Pounds per foot of row or per plant of cultivated area with percentage of increase or decrease (—) for paper mulch

Vegetable	Variety	Distance between		Yield of cultivated area per foot or plant	Increase from paper
		Rows	Plants or hills		
		In.	*In.*	*Lb.*	*Pct.*
Spinach	Long Season Bloomsdale	14	Drilled	.25	48
Head lettuce (plants)	New York	14	12	.83	28
Head lettuce (seed)	New York	14	12	.77	—4
Onions (plants)	Sweet Spanish	14	4	1.89	1
Onions (seeds)	Yellow Globe Danvers	14	Drilled	.62	—11
Beets (early)	Detroit Darke Red	14	Drilled	1.21	35
Beets (late)	Detroit Darke Red	14	Drilled	.64	20
Carrots (early)	Chantenay	14	Drilled	1.23	0
Carrots (late)	Chantenay	14	Drilled	.31	71
Peas (early)	Laxtonian	26	Drilled	.35	41
Peas (late)	Laxtonian	26	Drilled	.03	47
Celery	White Plume	26	6	.48	32
Cabbage (early)	Copenhagen Market	26	24	2.56	44
Cabbage (late)	Danish Ballhead	26	24	2.07	—1
Cauliflower (early)	Early Snowball	26	24	1.27	41
Cauliflower (late)	Dry Weather	26	24	.76	92
Potatoes (early)	Irish Cobbler	26	12	1.42	21
Snap Beans (early)	Giant Stringless	26	12*	.46	5
Snap Beans (early)	Pencil Pod Black Wax	26	12*	.42	5
Snap Beans (late)	Giant Stringless	26	12*	.24	39
Snap Beans (late)	Pencil Pod Black Wax	26	12*	.21	48
Lima Beans (bush)	Fordhook	26	12*	.43	10
Peppers	Early Giant	26	24	1.43	63
Egg Plant	Mammoth purple	26	36	3.08	75
Sweet Corn	Golden Bantam	26	12*	.34	27
Sweet Corn	Country Gentleman	26	12*	.45	26
Tomatoes (staked)	Bonny Best	50	24	6.27	23
Tomatoes (unstaked)	Marglobe	50	48	15.67	7
Cucumbers	Early Fortune	50	24*	3.14	44
Turnips	Purple Top White Globe	14	Drilled	1.27	—11

*2 plants per hill.

6. In 1928, 27 out of 30 crops of 18 kinds of vegetables produced as large or larger yields from the paper-mulched section.

7. Some mulching papers shrank and curled badly, making them unsatisfactory. Insulating or building papers severely stunted and even killed the seedlings of some vegetables.

8. The heavier weight papers are preferred for use in the home garden where it is necessary to walk upon the paper.

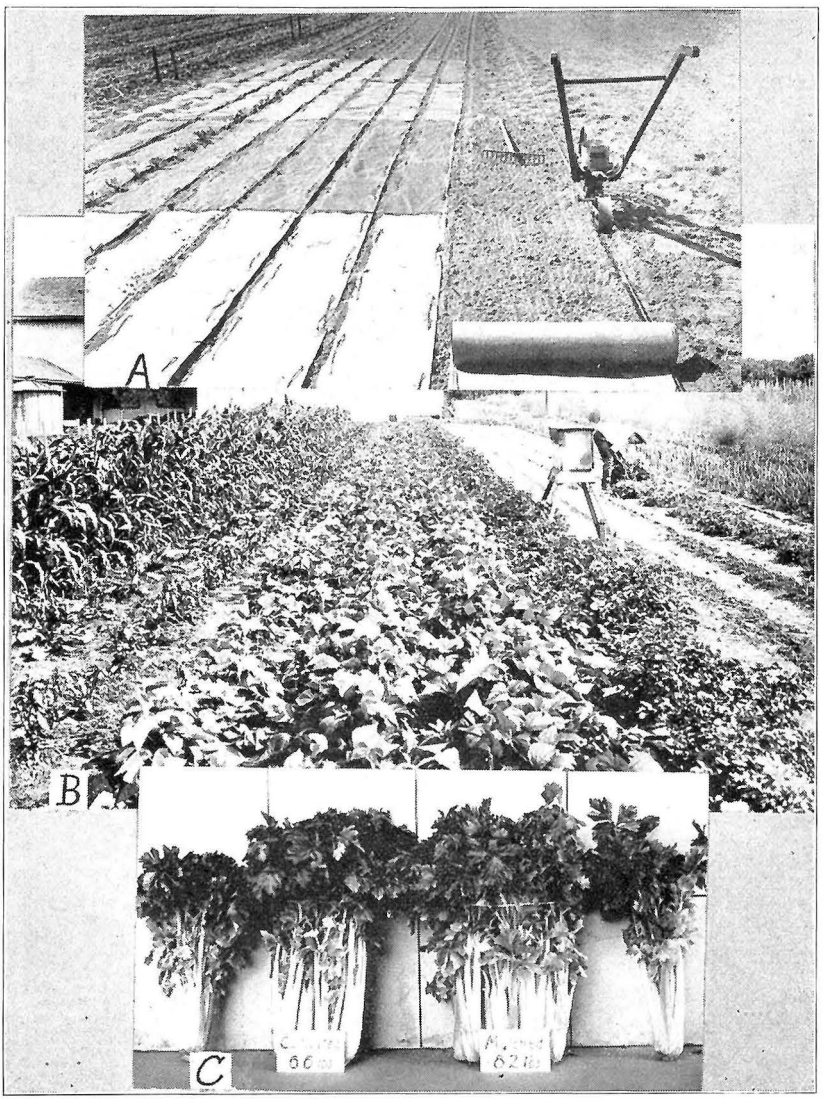
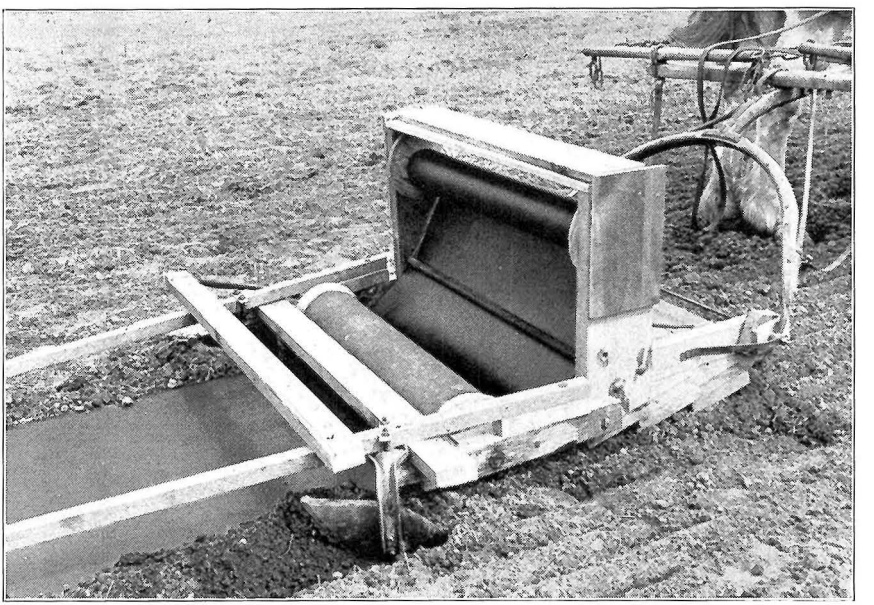


Fig. 9.—A—Procedure in planting garden and laying paper: seed planted or plants set, ground leveled by raking, two-foot strip of paper being unrolled, one-foot strips laid and held in place by wire wickets. Blocks of paper in test extend crosswise of garden.
B—View of paper mulch garden, July 12, 1928. Vines of early crop peas being removed. Shelter for soil thermograph near center.
C—Average dozen first grade stalks of White Plume celery from cultivated area, left center; paper mulch, right center. Single stalks at sides are largest from mulched plots.

RECOMMENDATIONS

For vegetables that are drilled thick in rows, such as carrots, beets, and spinach, it is necessary to place the paper between the rows anchoring it with wire staples or stones or other heavy material placed along the edges or crosswise of the paper strips.

In the small home garden the section to be devoted to crops that can be planted in hills may be completely covered with paper, the one free edge being anchored as mentioned above. The plants may be set or seeds planted thru holes cut in the paper at the proper intervals. This system eliminates any cultivation but is practical only on small areas.



A home-made machine for smoothing the soil, laying the paper and covering the edges with soil in one operation

The use of soil as a covering along the edge seems to be the most practical method of anchoring the paper. The soil may be placed by a hand tool or with an easily-made horse-drawn machine similar to that shown in Figure ... The space between strips of paper will have to be cultivated to destroy weeds.

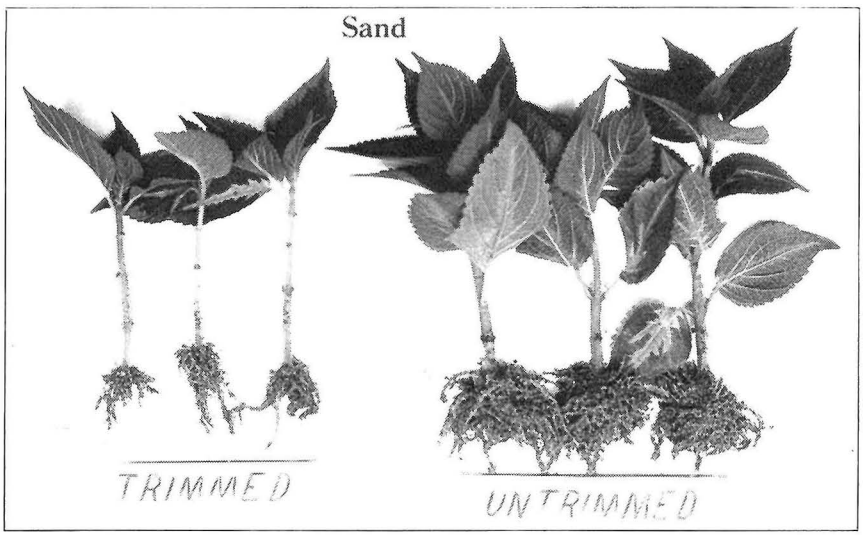
Paper mulch in the vegetable garden seems to be of most benefit on early, quickly-maturing crops, the warm season crops, and during periods of moisture shortage. Because of the cost of

material and hand labor required in planting it will prove profitable only on crops of high acre value that respond to its use with earlier or larger yields. (Roy Magruder).

FLORICULTURE

ROOTING CUTTINGS

Different media and combinations were used in an effort to determine the most satisfactory one to use in the propagation of flowers. Different types of cuts and different degrees of trimming were also tested.



Coleus from trimmed and untrimmed cuttings, started in sand

Sand, slag, peat moss, sphagnum moss, and combinations were used. Each of the media gave a satisfactory percentage of rooting when the cutting bench was properly handled. Care in the watering, shading, and heating of the cutting bench proved more important than the medium used. Media that held water gave a better percentage of rooted cuttings during hot, dry weather, while those that dried out quickly gave better results in cloudy, cool weather.

Cuttings made between the nodes rooted better than those cut at the node. With "heavy", "medium", and "no trimming", the non-trimmed cuttings gave the best results.

The cuttings from plants grown in partial shade and fertilized with nitrate of soda rooted with higher percentages than the cuttings from plants grown in full sunlight without nitrates added to the soil. Altho no chemical analysis of the plant tissue was made, the plants grown in the partial shade should be higher in nitrogen than the other plants. Softwood cuttings of too hard texture were found not to root as well as those with a softer texture. This may account for the higher percentages with the high nitrate cuttings.

(W. W. Wiggin).

SOIL ACIDITY IN GREENHOUSES

The reactions of greenhouse soils are being studied to determine their effect on growth, color, and keeping quality of the commercial flower crops. The changes produced in these soils by fertilizers and soil modification treatments are included in the studies.

Cyclamen and hydrangeas showed a preference for acid soils. Calendulas, Primula malacoides, Primula obconica, geraniums, callas, and cinerarias showed a preference for alkaline conditions. Carnations, chrysanthemums, and snapdragons varied in the reaction desired, depending on whether flower production or stem development were considered. No differences were noticed in the color of flowers except in the extremely alkaline plot in one instance.

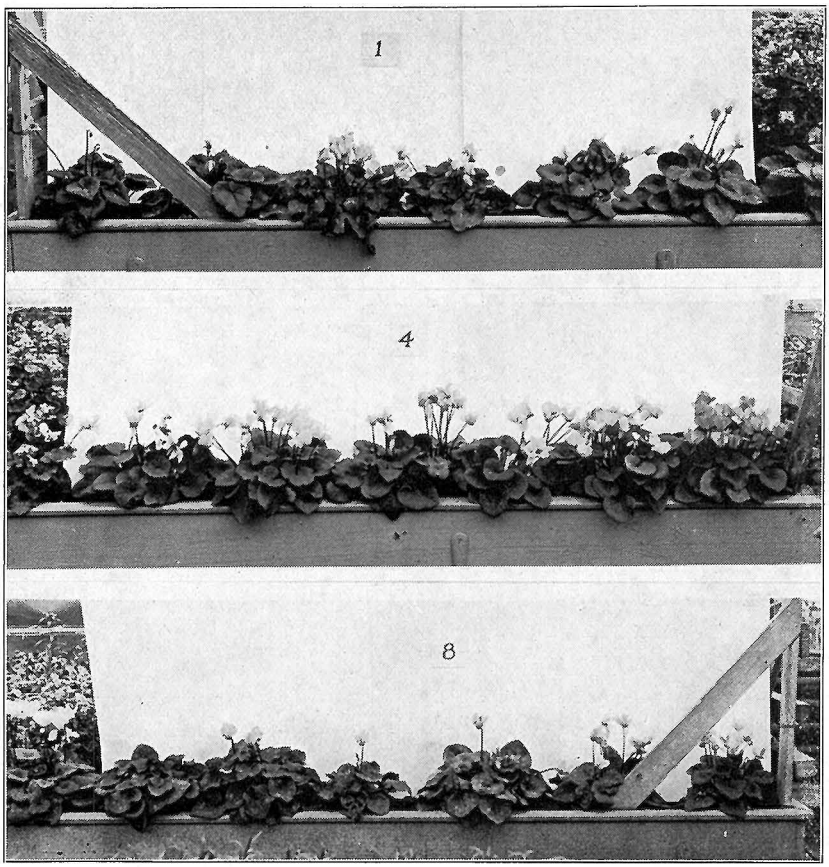
Differences in reaction were encountered at different times of the year, and when growing different types of crops. Of the waters tested that were used in greenhouse watering, all were alkaline in reaction. Sheep manure, cow manure, bone meal, nitrate of soda, a complete fertilizer, lime, slag, and Vigoro gave alkaline reactions in the soil. Peat moss gave a neutral to slightly acid reaction.

Difficulty was encountered in holding the plots at a given reaction, and this was particularly true with soil in pots.

(W. W. Wiggin).

CHRYSANTHEMUMS AND POMPONS

New unsterilized soil in raised beds did not give enough increase in size of chrysanthemum blossoms over those grown on a sterilized soil that had grown chrysanthemums for two previous seasons to warrant the expense of changing the soil. New soil gave increase of 2 to 12 inches in stem length of chrysanthemums



1 Cyclamen in bench pH 5 1928-29
4 Cyclamen in bench pH 6.5 1928-29
8 Cyclamen in bench pH 8.5 1928-29

over the old soil, but it is believed this increase in stem length can be secured much cheaper by earlier planting or by the use of a proper fertilizer than by changing the soil.

New soil gave increase over the old soil in the average number of shoots per pompon plant, average total number of flowers, and average stem length. The increase in return per square foot of bench space for the pompons would not warrant a change of soil under the conditions in this experiment.

These conclusions apply only in the case of beds. It is believed that even with these a change of soil in some cases would be beneficial. Where raised benches are used the soil should be changed each year. Tho a grower has never experienced difficulty in growing crop after crop on the same soil, even without sterilization, crop failures are so costly that every precaution should be taken to eliminate them.

With three varieties of pompons and anemone chrysanthemums 10- by 10-inch spacing gave larger returns per square foot with all varieties than did the 10- by 14-inch distance. Injury from diseases and insects is more probable when plants are set close together, lack of sunshine and circulation of air being responsible for the diseases and a better place to hide unnoticed and harder control conditions being responsible for the insect trouble. Growers must determine more or less for themselves the distances that give them the best results under their own particular growing conditions. (W. W. Wiggin).

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